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MANUAL

OF

MILITARY SIGNALING

FOR THE USE OF THE

REGULAR ARMY, NATIONAL GUARD,
MILITARY SCHOOLS AND COLLEGES.

By LIEUT. C. G. MORTON, R.Q.M.,
Sixth U. S. Infantry,
and LIEUT. H. H. BANDHOLTZ,
Sixth U. S. Infantry.

Price, Postpaid, . . . Fifty Cents.

FORT THOMAS, NEWPORT, KY.
1904

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PREFACE.

IN the recent rapid development of the Art of War, Military Signaling has kept pace with the other branches, and is now awakening a deeper interest and receiving more attention than it ever did before. Instructors and learners have, however, been handicapped by the non-existence of any condensed and authorized book of instruction covering the subheads into which signaling is divided. Separate pamphlets describing the different methods have been issued, but most of these are exceedingly brief and go into few details.

The advantages to be derived from condensing the information required for the instruction of the signal classes at Army Posts, and so arranging it that it could likewise be used by Military Colleges and the National Guard, first suggested to the undersigned the idea of compiling this information into the present manual.

The compilers lay no claim to originality, but have carefully arranged under one cover the instructions emanating from the U. S. Signal Bureau, adding thereto, from standard works, such practical information as might be pertinent to the subject, and which, from their experience as Acting Signal Officers at different military posts, they consider would benefit or interest instructors and learners. It is also thought that the book will be of use to amateur telegraphers, as it contains all the information necessary for the construction and operation of short lines.

The pamphlet on the Heliograph, by Lieutenant R. E. Thompson, Sixth Infantry, now Captain, U. S. Signal Corps, authorized by G. O. No. 99, 1888, and Signal Codes and Instructions authorized by G. O. No. 12, 1886, G. O. No. 59, 1889, and G. O. No. 34, 1893, have been freely, and in most cases, fully quoted. Much valuable information was also obtained from consultation of the following authorities:

Reports of the Chief Signal Officer, U. S. Army, 1886–93 inclusive; Myer's "Manual of Signals"; Swift's "The Practical Telegrapher"; Lockwood's "Handbook of the Electric Telegraph," and Pope's "The Electric Telegraph."

C. G. MORTON,
1st Lieut. R. Q. M., Sixth U. S. Infantry.

H. H. BANDHOLTZ,
2nd Lieut. Sixth U. S. Infantry.

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MANUAL

OF

MILITARY SIGNALING

EXTRACTS FROM THE U. S. ARMY REGULATIONS.

1. Officers of the signal corps, and those placed on signal duty in orders from the War Department, as fully qualified, will be styled "signal officers"; those assigned to such duty by other authority will be known as "acting signal officers."

2. The senior signal officer of an army in the field commands the signal parties serving therein. Orders affecting them will be transmitted through him, and he will be responsible that they are fully instructed, adequately supplied, and that they properly perform their duties. He will keep himself informed of the position of the army and of the enemy; and, under the instruction of the general commanding, will establish his stations to the greatest advantage. He will submit reports of operations to the general commanding, and will forward copies thereof to the Chief Signal Officer in Washington, to whom he will report monthly his station, the strength and condition of his parties, and all other matters pertaining to their duties and equipments.

3. Signal officers in the field will report to their immediate commanders, and to the senior signal officer, for the information of the general commanding, all movements of the enemy, and other facts, of interest to the service, coming within their knowledge.

4. When telegraph lines are, by order of the Secretary of War, placed in charge of signal officers, they will be held responsible

for their construction, maintenance, and operation. Commanding officers and others will see that the especial duties of these officers are not interfered with, and will, upon proper application, render such assistance as may be in their power.

5. Official and military messages will have precedence on the Government telegraph lines. Communications transmitted by telegraph or signals are always confidential, and will only be revealed to those officially entitled to receive them.

6. In time of peace, department commanders will attend to the instruction and practice in military signaling of the line officers and enlisted men in their departments. To this end they will cause an acting signal officer to be appointed at each military post, who shall give the necessary instruction and supervise field practice during at least two months of each year. Constant instruction will be maintained until at least one officer and four enlisted men of each company are proficient in the exchange of both day and night signals by flag, heliograph, or other device. The detail will be changed from time to time, so as to insure that each company shall always have a sufficient number of instructed officers and men, competent to maintain, by signals, distant communication in the field. Monthly reports of instruction and practice will be rendered to the Chief Signal Officer through department commanders.

7. Signal equipments, property, and stores will be furnished by the Signal Bureau to military posts, and such organizations as require them, on requisitions approved by department commanders. They will be receipted for by signal officers, or those acting as such, and will be regularly accounted for to the Chief Signal Officer on forms furnished for the purpose. Issues of instruments and equipments will not be made except to signal officers, or officers acting as such.

8. Telescopes, field glasses, heliographs, and telephones, when unserviceable, will not be submitted to an inspector for condemnation, but will be reported to the Chief Signal Officer for suitable disposition.

9. Officers of the Quartermaster's and Subsistence Departments will issue to signal parties serving in their vicinity such supplies as may be necessary for their proper equipment and subsistence, on the requisition of the officer in charge of such parties. The cost of such supplies will be reimbursed from the appropriation for the Signal Service. The receipt of the officer or agent receiving the stores will be taken by the officer making the transfer, for file with his returns, and such receipts must show that the request has been made for reimbursement of the cost of the stores so transferred.

U. S. ARMY SIGNAL AND TELEGRAPH CODE.

(Authorized by G. O. No. 59, A. G. O., June 28, 1889.)

10. ALPHABET.

A - —	H - - - -	O - -	V - - - —
B — - - -	I - -	P - - - - -	W - — —
C - - -	J — - — -	Q - - — -	X - — - -
D — - -	K — - —	R - - -	Y - - - -
E -	L ——	S - - -	Z - - - -
F - — -	M — —	T —	& - - - -
G — — -	N — -	U - - —	

11. NUMERALS.

1 - — — -	3 - - - — -	6 - - - - - -	9 — - - —
2 - - — - -	4 - - - - —	7 — — - -	0 ——
	5 — — —	8 — - - - -	

12. PUNCTUATION MARKS.

Comma, - — - —	Exclamation, — — — -
Semicolon, Si	Parenthesis, Pn
Colon, Ko	Brackets, Bx
Period, - - — — - -	Dollar mark, Sx
Interrogation, — - - — -	Dash, Dx
Quotation, Qn	Hyphen, Hx
Paragraph, — — — —	Underline, Ux

NOTE.—A fraction is made by inserting a dot between the numerator and denominator—Example, $\frac{7}{8}$, — — - - - — - - - -

13. SIGNALS AND ABBREVIATIONS.

1. Wait a moment.
4. Start me.
5. Have you anything for me?
7. Are you ready?
8. Busy on other wires (or stations).
9. Train order (or important military message) — give way.
13. Do you understand?
18. What is the matter?
27. Adjust your magnet (or flash).
30. Circuit closed (or close station).
44. Answer quick.
73. Accept compliments.
92. Deliver (ed).
134. Who is at the key (flag, or torch)?

Ahr. Another.
Ans. Answer.
Ck. Check.
Col. Collect.
D H. Dead head.
G A. Go ahead.
G E. Good evening.
G M. Good morning.
G N. Good night.
G R. Government rate.
N M. No more.
O B. Official business.
O K. All right.
Opr. Operator.
Pd. Paid.
Qk. Quick.
Sig. Signature.

THE FLAG.

14. Signal flags are made of muslin or some other light and close material. The flags ordinarily used are four in number:

a. The four-foot white: four feet square, having at its center a red block sixteen inches square.

b. The four-foot red: four feet square, having at its center a white block sixteen inches square.

c. The two-foot white: two feet square, having at its center a red block eight inches square.

d. The two-foot red: two feet square, having at its center a white block eight inches square.

In addition to the above, a black flag with a white center is sometimes employed.

For longest distances six-foot flags, with a block in the center two feet square, may be used. All flags are fitted with strings for tying them to the staff.

15. The signal staff is generally made of hickory, in joints of four feet each. A three-joint staff is used with all but the largest flags, where a four-joint staff is employed. For practice only, a staff of two joints, each three feet in length, is used with the smallest flag. The joints are tipped and guarded with brass, and are fastened together in the manner of a jointed fishing rod. The staffs taper from tip to butt, which, in the three-joint staff, is about one and one-quarter inches in diameter.

16. In an emergency a handkerchief, a shirt, or any similar article can be used in place of the flag, substituting for the staff a rifle, ramrod, sword, sabre, or even a stick. In case none of these are convenient, it could be waved by the hand.

TO SIGNAL WITH THE FLAG.

17. The flagman faces exactly toward the communicating station; staff is vertical in front of center of body, butt at height of waist. The dot (-) is represented by a motion to the right, and the dash (—) by a motion to the left of the sender. The space, whether separating elements of spaced characters (C, O, R, Y, Z, and "&"), or separating words, will be represented by the "front" motion.

Thus, the motions:

Right, right, front, right, represent C.
Right, front, right, represent O.
Right, front, right, right, represent R.
Right, right, front, right, right, represent Y.
Right, right, right, front, right, represent Z.
Right, front, right, right, right, represent &.

Each motion will embrace an arc of ninety degrees, starting from and returning to the vertical.

The long dash (letter "L" and numeral "naught") is distinguished from the "T" dash by a slight pause at the lowest point of the dip, and, with this exception, there will be no pause whatever between the motions required for any single letter.

A slight pause will be made between letters.

At the end of each word, abbreviation, or conventional signal the space signal, or "front" motion, is made, preceded and followed by a pause equivalent to that made between letters.

CONVENTIONAL SIGNALS FOR FLAG.

NOTE.—Each station should have its characteristic signal or call letter, as Washington, "W," and each operator his personal signal, as Jones, "Jo."

18. To call a station: Signal the "call letter" of the station wanted, or, if the call letter be not known, signal "A" without pause until acknowledged. The calling station will then proceed with the message.

To acknowledge a call: Signal "I" three times, followed by "front" and the call letter of the acknowledging station.

To break or stop the signals from the sending station: Signal "A" without pause until acknowledged.

To start the sending station after breaking: Signal "G A," followed by "front" and the last word correctly received; the sender will immediately resume his message, beginning with the word indicated by the receiver. If nothing has been received signal "R R;" the sender will then repeat all.

Error in sending: Signal seven dots (- - - - - - -) rapidly, followed by "front," and resume the message, beginning with the last word correctly sent.

End of address: Signal the period (- - — — - -) followed by "front."

Signature follows: Signal "Sig" followed by "front."

To acknowledge receipt of a message: Signal "O K," followed by "front," and personal signal or initial of receiver.

LEARNING THE CODE.

19. The memorizing of the letters, numerals, etc., will be facilitated by grouping them as follows:

1. Those which consist wholly of dots: E, I, S, H, P, and 6.

2. Those which consist wholly of dashes: T, L, M, 5, and "naught."

3. Those which are the reverse of each other: A and N, B and V, C and R, D and U, G and W, J and Comma, Q and X, Z and &, 4 and 8.

4. K is made from F, and 9 from 1, by substituting dots for dashes and dashes for dots. O and Y should be remembered together. In the numerals 1, 2, 3, and 4, each begins with the same number of dots as it contains units. Q and X are the most difficult to distinguish, but this may be overcome by remembering that Q comes first in the alphabet and has the most dots in the beginning.

WAND PRACTICE.

20. As a preliminary step to signaling with the flag and torch, a wand is used. This consists of a round stick about eighteen inches long and three-eighths of an inch in diameter. It is held loosely between the thumb and the base of the forefinger of the right hand, and steadied by the pressure of the lower edge of the hand. It is used in a similar manner to the signal flag, and will qualify a recruit in a shorter time than any other known method.

THE TORCH.

21. Each station is supplied with a flying and a foot torch. The flying torch consists of a copper cylinder eighteen inches in length and one and one-half inches in diameter. One end is closed, an opening fitted with a screw cap being left near this end for filling. The other end is left open for the wick. On the sides near this end are four openings, so arranged that from whatever direction the wind may blow there will be a draft through the wick. The flying torch is furnished with two copper clamps for attaching it to the staff.

The foot torch is the same as the flying torch, except that its diameter is two inches.

22. Wicks are made from cotton waste. Common floor mopping cut into lengths of about six inches, and tied with soft cotton twine, is very good for the purpose. The wick should be inserted in the open end of the torch just tight enough to keep the oil from dripping out when the torch is held upside down. This being done, the torch should be filled, through the opening made for that purpose, with coal oil or turpentine. The latter is superior to the former in that it does not have the same tendency to drip.

23. Each torch is fitted with a flame shade, which consists of a piece of thin copper, in appearance something like a washer, and

which is fitted by a socket upon the torch in such a manner that it projects about two inches on all sides. This shade is placed about one inch below the openings at the wick end of the torch. The function of the shade is to prevent the flame from traveling down the torch and thus overheating it. It is always detached when the torch is packed. Each torch is fitted with wedge strips below the openings, upon which the shades can be tightened by being pressed down firmly.

A wind shade is sometimes used in high winds. It consists of narrow strips of copper projecting from a socket, which is adjusted upon the torch in the same manner as the flame shade.

24. A funnel, a pair of shears, and a pair of pliers accompany each set of torches, for use in filling.

A wormer is also supplied, to be used when the wick may by accident be drawn so far into the tube of the torch that it can not be seized by the pliers.

25. The burning fluid for the torches is carried in a copper canteen capable of containing half a gallon. The rest of the fluid is kept in a copper can of five gallons capacity.

26. A haversack goes with the outfit, and is used for carrying the wicking, matches, shears, pliers, funnel, shades, etc. The matches should be wind or vesuvius matches; *i. e.*, those so prepared as to be inextinguishable by wind or rain.

27. The torches are carried in a case made of rubber cloth, about three feet long by about two and one-half feet wide. This case has pouches on one side and ties on the opposite; the torches are placed in the pouches, and the case rolled around them so as to envelop them in two or three folds, and then tied.

A canvas case, called the kit case, fitted with straps, contains the staffs, flags, torch case, and wormer. The kit case, canteen, and haversack all have shoulder straps, by means of which they may be easily carried.

28. When in use, the flying torch is fastened by means of its clamps to the end of the third joint of a four-joint staff, or to the end of the second joint of a three-joint staff.

29. To send a message: fill both torches, light the foot torch and place it on the ground a few feet in front of the signal man, and in a line with himself and the signal station. The flying torch is then lighted at the foot torch.

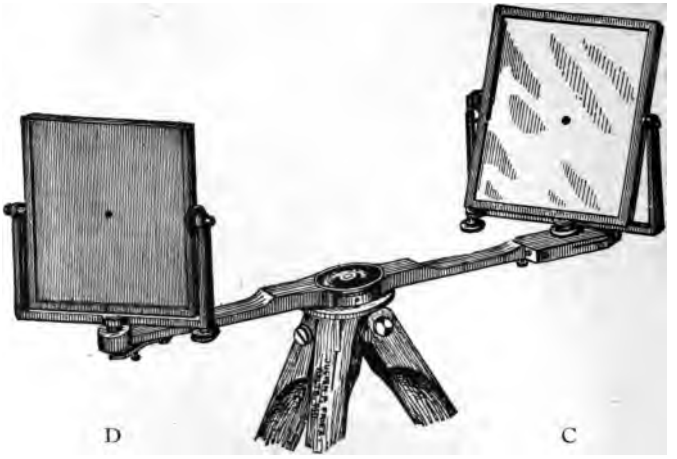
The positions, motions, and conventional signals for the torch are identical with those for the flag.

30. The foot torch can be refilled without extinguishing, and the flying torch should be refilled every fifteen minutes. This is done by lowering it from the vertical to the left at the end of a word, extinguishing, refilling, lighting it at the foot torch, and then again raising it to the vertical, and resuming the message.

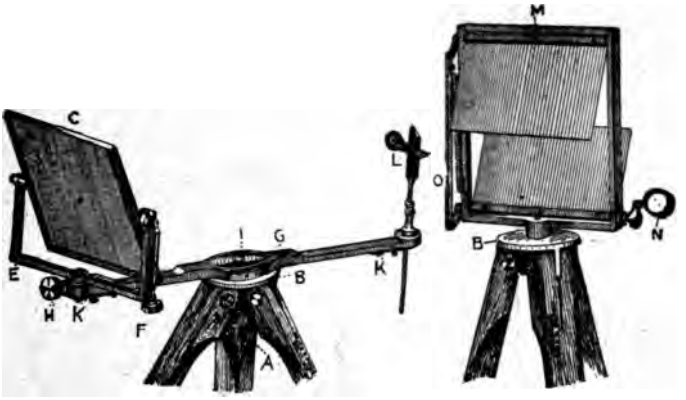
31. At the conclusion of each message the flying torch should be extinguished, but the foot torch should be left burning as long as the signaling continues. When the flame of the flying torch increases in size and emits a sighing sound, it is an indication that the torch is overheated. It should then be brought to a vertical position and held there for a few minutes until the flame has diminished to a proper size.

32. When torches are broken or can not be obtained, lanterns can be utilized by attaching them to poles, or by waving them with the hand. A firebrand is also a good substitute, and a small fire may take the place of the foot torch when the burning fluid is nearly exhausted.

THE HELIOGRAPH.



HELIOGRAPH WITH TWO MIRRORS.



HELIOGRAPH WITH ONE MIRROR. SCREEN IN POSITION.

33. The following description of the heliograph and instructions for its use are taken from a pamphlet written by First Lieut. R. E. Thompson, 6th Infantry, now Captain U. S. Signal Corps, and authorized by G. O. No. 99, Hdqrs. of the Army, A. G. O., Nov. 15, 1888.

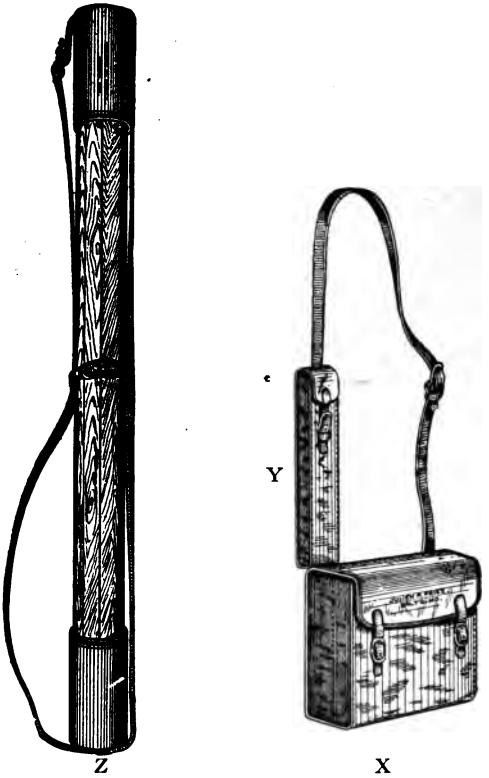
34. The field heliograph equipment consists of—

X. A sole-leather pouch, containing:
One sun mirror.
One station mirror. } Inclosed in a wooden box.
One screen. One sighting rod. One screwdriver.

Y. A smaller pouch, sliding by two loops upon the strap of the larger, containing: One mirror bar.

Z. A skeleton leather case, containing: Two tripod stands.

A. Tripod.
B. Tripod head.
C. Sun mirror
D. Station mirror.
E. Mirror supports.
F. Tanget screw for revolving mirror about horizontal axis.
G. Mirror bar.
H. Tangent screw with ball bearings for revolving mirror about vertical axis.
I. Clamp screw for attaching mirror bar to tripod.
K. Spring for clamping mirrors and sighting rod.
L. Sighting rod with movable disk.
M. Screen.
N. Key for screen.
O. Screen spring.



HELIOGRAPH EQUIPMENT PACKED.

35. The sun mirror has an unsilvered spot at its center, the i tion mirror a paper disk; in other respects they are similar. T tangent screw attachment to the frame affords the means of revc ing the mirror about a horizontal axis. The support to the fra has a conical projection accurately turned to fit the socket of mirror bar, and grooved to receive the clamp spring.

36. The screen has two shutters, operated by means of a k The base of the frame carries a female screw for attachment to tripod.

37. The sighting rod is fitted to the socket of the mirror bar, and is clamped in the same manner as the mirrors. It carries at one end a movable disk, which, when turned down, reveals the front sight. A piece of white paper should be slipped into the disk to receive the "shadow spot," and a slight puncture made therein, coincident with the point of the front sight, as guide in adjustment. Vertical adjustment of the disk is made possible by loosening the milled slide.

38. The mirror bar is provided with a clamp, threaded to fit the screw of the tripod. The release of the clamp permits movement of the bar independent of the screw. At one end is attached the tangent screw for revolving mirror about a vertical axis, and it should be observed that under all circumstances the sun mirror should be clamped to this end, while the socket at the other extremity is designed to receive the station mirror or the sighting rod. A movable spring is placed under each end of the bar for clamping mirrors and sighting rod.

39. The tripods are similar, the screw of either serving equally well for the attachment of mirror bar or screen. Both are provided with a hook for the suspension of a weight to give greater stability when required.

SETTING UP AND ADJUSTING.

40. The position of the sun is the guide for determining whether one or two mirrors should be used. When the sun is in front of the operator, that is, in front of a plane through his position, at right angles to the line joining the stations, the sun mirror only is required; with the sun in rear of this plane, both mirrors should be used, although a single mirror may often be worked to advantage with the sun well back of the operator. In the former case the rays of the sun are reflected from the sun mirror direct to the distant station; in the latter, they are reflected from the sun mirror to the station mirror, thence to the distant observer.

41. With one mirror: Set the tripod firmly on the ground, attach the bar to the tripod, insert and clamp in their appropriate sockets the sun mirror and the sighting rod, the latter with its disk turned down. Sight through the center of the mirror and turn the bar and raise or lower the sighting rod until the center of the mirror, point of sighting rod and distant station are accurately in line; then clamp the bar firmly to the tripod, taking care not to disarrange the alignment. Turn up the disk of sighting rod. Move the mirror by means of the slow-motion screws until the "shadow spot" falls upon the disk of the sighting rod; flash will then be visible to the distant observer. The

spot must be kept in the center of the disk while signaling. Attach the screen to the tripod, and place it close to, and in front of, the sighting disk, so as to intercept the flash.

42. With two mirrors: Set the tripod firmly on the ground, clamp the bar diagonally across the line of vision to the distant station, clamp the sun mirror facing the sun, to the end of bar with tangent screw attachment, and the station mirror facing the distant station, to the other socket. Stooping down, the head in rear of, and near the station mirror, turn the sun mirror by means of its slow-motion screws until the whole of the station mirror is seen reflected in the sun mirror, and the unsilvered spot and reflection of the paper disk accurately cover each other. Still looking into the sun mirror, turn the station mirror until the reflection of the distant station is brought accurately into line with, or is covered by, the unsilvered spot and the reflection of the disk; after this, the station mirror must not be touched. Now stepping behind the sun mirror, throw upon the station mirror a full flash from the sun mirror, so that the shadow spot falls upon the center of the paper disk. The flash will then be visible at the distant station. The shadow spot must be kept in the center of the paper disk while signaling. Attach the screen to its tripod and place it so as to intercept the flash, in a position convenient for maintaining adjustment of the sun mirror while working.

43. Signaling is effected by depressing the screen for periods of time required to display flashes corresponding to dots and dashes. The dot is represented by a momentary exposition of the flash, and the duration of this exposition constitutes the unit of time. The dash is represented by an exposition of the flash for a period of three units of time. The pause between the elements of a letter is equivalent to the unit of time; that between letters, to three such units; and between words, to six units.

REMARKS.

44. In setting up the instrument, spread the tripod legs sufficiently to give a good base, and on yielding soil press firmly into the ground, the head approximately level. In a high wind, ballast by hanging a substantial weight to the hook. If the legs become loose at the head joints, apply the screw driver to the assembling screws.

45. See that the screen completely obscures (cuts off) the flash, also that the flash passes entire when key is depressed. The spiral spring should return the screen sharply to its normal position when key is released. If it fails to respond promptly, strengthen or replace.

46. Extra care bestowed on preliminary adjustment is repaid by increased brilliancy of flash. With alignment absolutely assured, and the shadow spot at the center of the disk, the axis of the cone of reflected rays is coincident with the line of sight, and the distant station receives the greatest possible intensity of light. The distant operator is necessarily the best judge as to the flash received; if, therefore, adjustment is called when the shadow spot is at the center of the disk, alignment is at fault. Accuracy of alignment may be tested by looking into the sun mirror, bringing the eye into line with the unsilvered spot, the reflection of the disk, and reflection of the distant station. If now the position of the eye be changed, the unsilvered spot and reflected disk will no longer cover, but the lines of their centers in all positions will intersect at the reflection of the station, if alignment be true.

47. The tendency of the shadow spot to move off the disk, due to the apparent motion of the sun, is compensated for, without interrupting signals, by means of the tangent screws of the sun mirror. The movement imparted by these screws to the mirror does not disturb alignment, as its center (the unsilvered spot) is at the intersection of the axis of revolution.

48. It is of the utmost importance that uniformity in mechanical movement of the screen be cultivated, as lack of rhythm in the signals of the sender entails unnecessary and vexatious concentration of attention upon the receiver. The contrast between dots and dashes should be unmistakable. For the dot, the flash is almost instantaneous. To avoid continuity of light, release the screen at the moment of depression. For the dash, dwell somewhat upon exposure, with a tendency to lengthen rather than shorten the period of duration prescribed.

49. The manipulation of the instrument involves but slight manual labor; the strain on the eyes, however, from the flash of the mirror in receiving, is often considerable, but may be modified by the use of stained glasses. It will also occasionally be found advantageous to screen the eyes from the glare of surrounding objects.

Ability to read signals from the heliograph may be readily acquired, but may also be as readily lost if practice be discontinued before proficiency is attained. It should therefore be the endeavor to acquire such facility, not only in sending but in receiving, that habit will come to the aid even after the lapse of considerable time.

50. Minor parts of the instrument should be dismounted only to effect repair, for which purpose spare parts are furnished on requisition. All steel should be preserved from rust, and tangent screws and bearings from dust and grit. The mirrors should invariably be wiped clean before using. In case of accident

sun mirror the station mirror may be made available as such by removing the paper disk.

51. The projection of the rays of the sun upon a screen, by reflection from plane mirrors, demonstrates that for short distances (varying with the sizes of the mirrors employed) the figures of illumination are similar to those of the mirrors used. Removing the mirrors to a greater distance from the screen, it is found that the shapes of the mirrors are no longer reflected, but that all images are circular and of the same diameter. Removing the mirrors to a still greater distance, it is found that the various images are circular as before and of the same diameter, but that this latter diameter is greater than the one previously obtained. Repeating the experiment at increased distances, these results are confirmed, with the following conclusions:

a. That up to a certain distance the form of the mirror is reflected upon the screen.

b. That this distance once exceeded, the reflected images obtained from mirrors of various shapes and sizes are all circular and of equal diameters at equal distances.

c. That the greater the distance from the mirror to the screen, the greater the diameter of the reflected image.

d. That the images vary in brightness, the larger mirrors producing the brighter images.

It is therefore evident that the advantage derived from the use of a large mirror consists, not in any increase in the size of the flash, but in an increase of brightness; that is, capability for overcoming such obstructions as fog, smoke, haze, and consequently distance.

52. The light from the sun is projected upon the surface of the mirror in a cone of rays, and is reflected in a cone of the same dimensions. The angle within which the reflection is visible is that subtended by the diameter of the sun. The limit of the lateral extension of the flash at any given distance may therefore be definitely determined, and it is found that the circle of illumination has a diameter which increases sixteen and one-third yards for every mile of distance from the mirror. As the diameter of the flash increases directly with the distance between stations, adjustment of the instrument is quite as simple and certain for great as for short distances. Although the margin of flash is ample, so that signals may be directed upon a station, however distant, with certainty, yet it is so slight relative to the distance between communicating points that signals are invisible to one far out of the direct line, and are therefore not liable to be read by those for whom not intended.

53. It is evident from the proportion between the diameter of the flash and the distance, that the instrumen[illegible]sed in esti-

mating distance between stations. In practice, the dispersion of rays due to imperfections of the mirror makes the determination of the exact limit of the flash a matter of some uncertainty, but a fair approximation to the true distance may often be obtained when conditions are favorable.

54. For permanent stations an eight-inch mirror is contemplated, with provisions for attachment to a post, the stump of a tree, or to some other firm base, by means of screws, dispensing entirely with the tripod. The range over which signaling may be effected by means of this instrument, under favorable atmospheric conditions, is limited only by the convexity of the earth. The square mirror is adopted in preference to the round, as containing about one fourth more reflecting surface for practically the same packing space. Signaling at moderate range by night may be effected by moonlight; also by the employment of artificial light. This latter fact makes possible practice with the instrument in the squad room.

CONVENTIONAL SIGNALS FOR HELIOGRAPH.

55. To call a station: Turn a steady flash on the station and keep it there until answered by a steady flash. Both stations will then adjust, each on the other's flash. When adjustments are satisfactory, the station called will acknowledge and cut off its flash, and the calling station will proceed with the message.

To acknowledge a call: Signal "I" three times, followed by the call letter of the acknowledging station.

To break or stop the signals from the sending station: Signal "A" without pause, until answered by a steady flash.

To start the sending station after breaking: Signal "GA," followed by the last word correctly received; the sender will immediately resume his message, beginning with the word indicated by the receiver. If nothing has been received signal "RR;" the sender will then repeat all.

Error in sending: Signal seven dots (- - - - - - -) rapidly, and resume the message, beginning with the last word correctly sent.

Adjustment: If the receiver sees that the sender's mirror needs adjusting, he will turn on a steady flash until answered by a steady flash. When adjustment is satisfactory, the receiver will acknowledge, and the sender will resume his message.

End of address: Signal the period (- - — — - -).

Signature follows: Signal "Sig."

To acknowledge receipt of a message: Signal "OK," followed by personal signal or initial of receiver.

THE SIGNAL LANTERN.

56. It is probable that, when perfected, the lantern will supersede the torch for night signals. It has many advantages, among which may be enumerated cleanliness, lightness and simplicity.

57. The following extract from a report of Capt. C. E. Kilbourne, U. S. Signal Corps, to Gen. Greely, Chief Signal Officer of the Army, describes the latest stage in the development of the signal lantern: "A model lantern has been constructed for this corps which resembles one of the English lanterns in general appearance, but is devoid of all signaling devices. This lantern promises to be satisfactory up to a distance of eighteen or twenty miles, which is as far as signal stations will ordinarily be separated. The new model has no chimney; it is simply a lantern constructed for the purpose of throwing out a powerful beam of light. For this purpose a reflector is placed behind the flame and the desired divergence is given to the rays of light by a plano-convex lens. The lantern is therefore a modification of the bull's-eye form. In signaling with this lantern the method employed is the same as that of transmitting sun flashes by the heliograph, the lantern being attached to the heliograph tripod by means of a female screw, and is so adjusted, by means of sights, as to direct the beam of light upon the distant signal station. The heliograph screen, which is always part of the equipment of a signal party, is then so placed as to cut off the entire light when closed, and permit the free passage of the rays when open. The illuminating fluid is the same as that used by bicyclists, a mixture of kerosene and sperm oil. The light given out is a brilliant one, and the lamp has been burned for hours without becoming heated to such an extent as to make it uncomfortable to handle, or to cause danger of explosion. Another model now under construction may prove more satisfactory for long ranges than the one above referred to. It is provided with a double oval wick, with air spaces in the center and between the wicks. By means of a tall, iron, telescopic chimney a strong draught is obtained; a reflector behind the flame insures a brilliant light; over three hundred and sixty candle power, according to the maker. With this lantern, as with the other one described, the signal apparatus is the heliograph screen."

58. A signal lantern may be extemporized by fitting an ordinary lantern with a screen easy of manipulation.

59. The conventional signals for the lantern are identical with those for the heliograph.

TELESCOPES AND FIELD GLASSES.

60. For receiving messages from points more remote than can be reached by the unaided eye, telescopes and field glasses are used. The field glass has less power than the telescope, but will quickly cover larger tracts of country, and can be used without a rest. The telescope is used for long distances, and where there is time and opportunity for fastening it to a rest.

61. The rests provided by the Signal Corps are made of brass, with a padded clamp for holding the telescope firm, and a ball and socket bearing to enable it to be pointed in any direction. At the end is a large screw, which forms part of the rest, and by means of which it can be securely fastened to a fence, tree, or other firm wooden support. A convenient improvised rest would be a stump, stone wall, or any similar object covered with a blanket, upon which the telescope should be placed and weighted down with stones.

62. All lenses should be kept thoroughly clean, old newspapers or other soft paper being used for this purpose. The eye-piece ends should always be covered when the telescope is carried in wet weather, as otherwise the glass might be ruined by being filled with water. Telescopes and field glasses are carried in cases provided with straps for slinging over the shoulders.

63. The Signal Corps is now issuing field glasses with aluminum frames. Their lightness (the weight being only one-half that of the ordinary metals used) enables the observer to use the glass free hand for a considerable time without fatigue.

FIELD STATIONS.

64. On account of the difficulty in reading signals at long distances, it is absolutely necessary that the greatest care be exercised in selecting the station.

65. When the flag is used, it is essential that there be a good background, and the location of the station should be such that all the motions will be outlined against this background when viewed from the receiving station. The best backgrounds are those that are dark colored, such as woods or green fields; but in any case, those which have more than one color should be avoided, as, for example, when part of the motions are outlined against a white house and the other part against trees or other dark objects. That flag should be used which contrasts most strongly with the background. The signalman should face squarely toward the receiving station, so that motions shall be seen to his right and left. He should also be stationed a little in advance and to one side of the person at the *glass, so that errors* may be noticed and corrected.

66. When signaling with the torch, the sender should stand directly in rear of the foot torch, as viewed from the receiving station, so that when a front motion is made the flame of the flying torch will appear to blend with that of the foot torch. The latter should be so placed that no obstacle shall intervene between it and the other station.

67. It is usual for signalmen to work in pairs, one reading the message while the other is sending, or one writing the message down while the other is taking it.

68. It often happens that moving stations, such as troops in the field supplied with a signal outfit, may wish to open communication with fixed stations. To do this, the attention of the latter must first be attracted. This may be done in the daytime by building a large fire, and putting upon it armfuls of straw or leafy branches. The dense white smoke resulting can be seen at a great distance. At night an ordinary fire may be used, alternately covering and uncovering it with a blanket, so that it may be distinguished from other fires in the vicinity. While the attention of the fixed station is being sought in this manner, it is well to wave the flag by day or the torch by night in the manner prescribed for calling a station whose call letter is not known. A fixed station should, if possible, maintain a constant lookout for signals.

69. Two moving stations should attract each other's attention in a manner similar to that indicated above. This may be done at preconcerted hours of the day or night; the watches of the persons in charge of the stations having been previously compared.

70. Stations should be located on as high ground as practicable, care being taken that they are not too near an encampment. If, in locating fixed stations, there are no natural heights, platforms may be built in tree tops or on the roofs of houses; in the absence of both of these, scaffolds may be erected from the ground. When obstacles intervene between two stations, intermediate ones should be established.

71. When important messages are sent, especially in cipher, it sometimes becomes necessary in order to secure accuracy that they be repeated by the receiving station. This may be done letter by letter, word by word, or sentence by sentence.

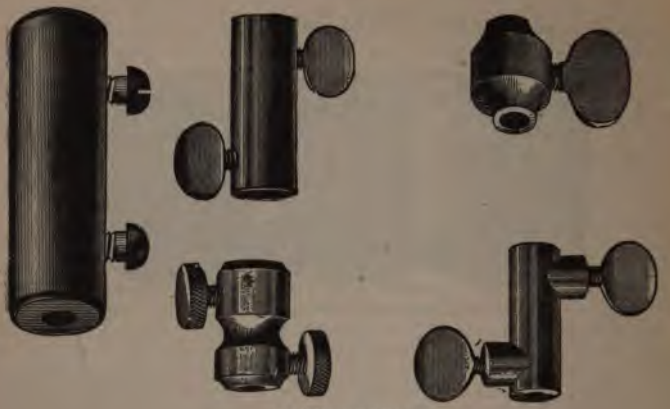
THE TELEGRAPH.

THE CROW-FOOT BATTERY.

BATTERIES.

72. The crow-foot form of the gravity battery is the one usually supplied for the construction of all permanent lines. A cell of this battery consists of a glass jar, at the bottom of which is placed a piece of copper connected with an insulated copper wire that runs above the top of the jar. Above the copper, and hanging from the edge of the jar, is placed a piece of zinc in the form of a crow's foot, and, hence the name of the battery. To charge the cell, fill it with copper sulphate until the copper is covered and then pour in water until the zinc is covered. The different cells should then be placed in a series by connecting the copper of one to the zinc of the next. The extremities of the battery are called the "copper" or "positive" pole, and the "zinc" or "negative" pole. Half the cells should be placed at one end of the line and half at the other. The opposite poles should be nearest each other.

73. The battery being located, connect one end of the line wire with the copper pole, and the other end with the zinc pole. The first connection may be made by a splice or by a connector made for the purpose. In either case the copper wire should have the insulation taken off for several inches and should be scraped perfectly bright.



CONNECTORS.

74. When set up as above described, it will take about forty-eight hours for the current to flow well. To hasten the action put about two ounces of zinc sulphate in each cell, and "short circuit" the battery by connecting the extremities with a short piece of wire. Warm water will also hasten the action.

75. The battery should never be allowed to freeze. The water lost by evaporation should be replaced, and when the blue color falls more than one inch below the bottom of the zinc more copper sulphate should be added. The liquid should not be shaken. About once in two months the battery should be taken apart and cleaned, the zincs and coppers scraped, and the former amalgamated if the materials are at hand. The process is to scrape the zinc, dip it in dilute sulphuric acid, and then rub mercury over it with a stick covered at one end with a rag.

76. For a flying telegraph line the best form of battery is the Eagle Metallic. The cell is of lead and answers for the positive pole, a zinc plate being used for the negative. There are two forms of cell, the square and the round. The former is used for main line purposes, and the latter for locals. The battery is carried in a box having a compartment for each cell. A cell is charged by putting about four pounds of copper sulphate in small lumps in the bottom, and covering this with a layer of clean pine sawdust about one inch deep. The zinc plate is placed on top of the sawdust, and the cell filled with fresh water. Immediate ac-

tion can be produced by putting on the sawdust about half an ounce of zinc sulphate and filling the cell with warm water. Strips of wood or rubber put in before the sulphate of copper, prevent contact of the zinc plate with the cell. The outside of the cell should be kept clean and dry, and a portion of the top water should occasionally be drawn off with a syringe and replaced with fresh.

77. The number of cells necessary to operate a telegraph line depends upon the perfection of the insulation and the resistance of the instruments and wire. Therefore no rule deduced from theory can be applied.

78. Assuming that the insulation is good, and that the other conditions are favorable, the number of cells given below has been found by experiment to answer the purpose. In all reference to wire hereafter, it is assumed that the American gauge is used for copper, and the Birmingham for iron wire, and that the latter is galvanized.

Lines of five miles or less:

No. 9 iron wire, one mile, eight cells; each additional mile, two cells.

No. 12 iron wire, one mile, nine cells; each additional mile, two cells.

No. 14 iron wire, one mile, ten cells; each additional mile, two cells.

The number of cells for intermediate sizes of wire may be calculated from the above.

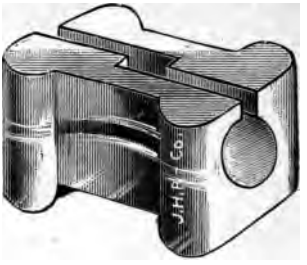
In addition, there must be added to the main line battery one cell for each sounder without relay, two for each relay, and three for each box sounder. The use of local batteries will be explained under the head of "Relays."

Lines of over five miles: Multiply the total resistance in ohms of the entire circuit by .025, and the result will be the approximate number of cells required.

CONSTRUCTION OF LINES.

LINES IN MILITARY POSTS.

79. For the outdoor wire of a line less than fifteen miles in length, such as is usually erected at military posts, No. 12 galvanized iron is best. This has about thirty-two feet to the pound, or 170 pounds per mile. Its resistance is thirty-two ohms per mile. But one wire is used, the earth making the return circuit. The wire must be insulated from all contact with buildings, posts, or trees, in order that the current may not escape to the ground. For this purpose the "Pony Glass Insulator" is ordinarily used.

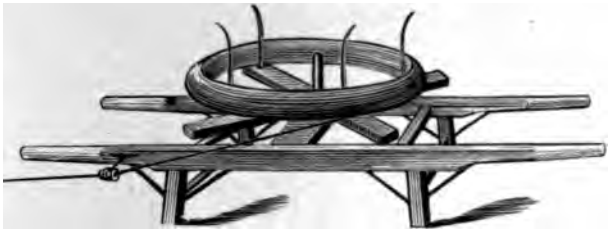


TREE INSULATOR.

It is screwed firmly upon an oak bracket, which, in turn, is securely fastened with two spikes, driven through holes bored for the purpose, into the pole, building, or whatever else is used as a support. The wire is rigidly attached to this bracket, as will presently be shown. Where a tree is used as a support, a special bracket is employed, which allows the line wire to slip freely through it as the tree sways in the wind. If an old hose can be found, which has been thrown aside as useless, a sound piece about four inches long may often be cut from it, and this, when strung on the line wire and bound securely to the tree, will answer every purpose.

80. Poles should be straight, neatly barked and trimmed, and not less than seventeen feet long and three inches in diameter at the top. They should be of the most durable wood that can be procured, and should be cut, if possible, when the sap is not running. A hollow iron pole twenty feet long and two and one-fourth inches in outside diameter is much used by the Signal Service for all kinds of line. This pole can be firmly set in sand, and will resist storms much better than a wooden one. It also obviates the danger of destruction from fires and lightning. The insulator is screwed upon a pin bracket, which is put into the top of the pole. An iron bar passes through a hole four feet from the top, for use as a foot rest while the wire is being fastened. The pole is climbed by means of a ladder suspended from the foot rest.

81. The line should be as nearly straight as possible, the post holes being about one hundred yards apart, except on curves, where they should be closer. A post auger is the best instrument for digging, and the holes should be so made that the poles may be straight when set, except on curves, where they should lean against the curve. Care should be taken to place them deep enough.



BARROW REEL.

82. When all is ready, the wire is unreeled along the line and the kinks taken out. If the pole is very light, the bracket with an insulator screwed on is attached to the pole while the latter is on the ground, a flat surface being made with a hatchet where the bracket is to rest. The pole is next erected, and the earth around it thoroughly tamped. When the pole is strong enough, the bracket may be attached after it is erected. In the latter case, when climbers are not used, a light ladder, held at the bottom by two men, will answer every purpose.

83. The line wire being taken to the bracket, a piece of the same kind of wire, about eight inches long, is cut, and bent into the form of the letter U. This is called a tie wire. The loop is put around the groove in the insulator, and the ends then turned up. The line wire is put against the insulator, between it and these upturned ends, and the latter are seized with a pair of pliers, twisted four or five times around the line, and then cut off close.

SPLICE.

84. To splice two ends, brighten them by scraping and lay them close to each other for about eight inches. Hold them in this position by a small hand vise, and then twist each end as shown in the illustration. The bracket should be on that side of the pole where the tension of the line wire will pull it close. The line wire should be on that side of the insulator nearest the pole, except on curves.

85. The two extremities of the line should be connected with the ground. This *may be done* by scraping a water or gas pipe

perfectly bright, and wrapping the end of the line wire around it tightly fifteen or twenty times. If none of these "grounds" are available, bury, out of the reach of frost, and deep enough to obtain moist earth, a sheet of copper two feet square, having a copper wire soldered to it for the attachment of the line wire.

PERMANENT LINES.

86. A longer line is constructed like those used for commercial purposes. The method is similar to that described above, but the following notes will be useful:

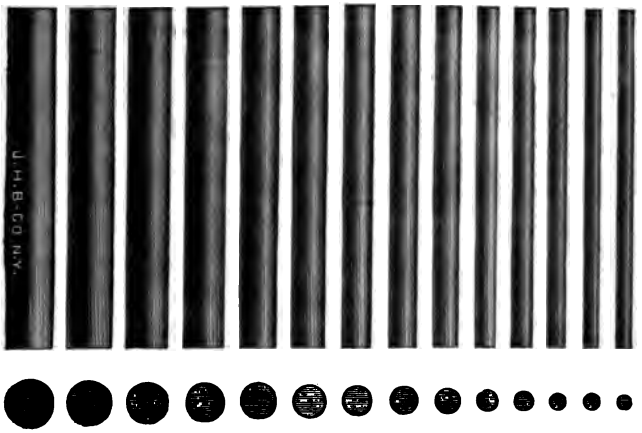
The materials needed are poles, line wire in half-mile coils, brackets, cross arms, insulators, spikes, bolts, nails for brackets, soldering apparatus, etc. The cross arms may be dispensed with if but one wire is to be put up, together with the spikes, bolts and

RUBBER HOOK INSULATOR.

pin brackets for the same. The insulator is shaped like the pony, but twice the size. A rubber hook insulator is used where the line passes under bridges, through tunnels, or where it is attached to the lower side of a window sill. The thread of the hook is screwed into a hole bored for the purpose, and the wire is twisted around the hook itself.

87. *The following* table describes the wire commonly used:

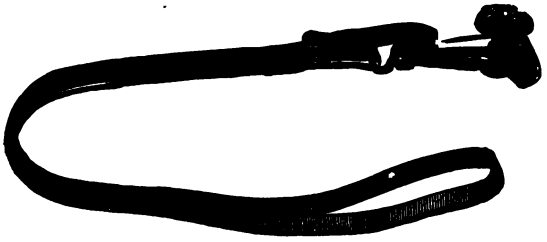
No.	Pounds per mile.	Resistance per mile.	Feet per pound.
4	730	7 ohms.	7.23
6	540	9.5 "	9.59
8	380	13 "	13.89
9	320	15 "	16.5



Nos. 3 4 5 6 7 8 9 10 11 12 13 14 15 16

GALVANIZED LINE WIRE.

88. A pole for one wire should be twenty feet long, and five inches in diameter at the top. If a second wire is to be strung, or the nature of the soil is such that deep setting is required, a pole twenty-five feet long should be used. For one or two wires, twenty-



HAND VISE AND STRAP.

five poles to the mile are needed. This number may be increased or diminished according to the nature of the country and the straightness of the line. If fire is to be feared, the sod may be dug up ten feet or more around the poles. If more than one wire is put up, cross arms should be used. An arm is made of white pine, is four by five inches in cross section, and for two wires, three feet long. A place about two inches deep is made for it on the pole with a saw and chisel, and the fastening is made with one bolt and two spikes, or with two bolts.

89. The tools needed are axes, block and tackle, brace and bits, butt prop, cant hook, chisels, climbers, climber's belts, pliers, digging bars, foot plate, files, hatchets, hand saws, pikes, post augurs, screw drivers, spoon shovels, long handled shovels, tamping bars, reel, hand vises and straps, blasting apparatus, grindstone, etc. A butt prop is used in raising heavy poles. It is made of strong plank, about ten feet long, and with one end hollowed out to receive the pole as the latter is being raised. The block and tackle are used to pull the wire up for the climbers. The cant hook turns the pole in the proper direction after it has been raised. Fry's splicing pliers are especially adapted to making a joint in a wire. Joints should be soldered. A foot plate is held inside and near the top of the hole while the pole is being raised. This keeps the earth from falling in. Pikes are used to raise the pole. The latter is steadied by two men, each pressing toward the other with his pike. A hand vise with its strap is used to pull in slack, to hold the wire for cutting, or to make a splice from the top of the pole.

FRY'S SPLICING PLIERS.

90. A proper working party would be one foreman, ten hole diggers, eight pole setters, two men for pulling up wire, four climbers, two men to reel out wire, and one for attaching brackets and cross arms. The reel is made fast in a wagon, and the wire uncoiled from the outer end. The tie wires should be thirteen or fourteen inches long. When put up in summer, a span of seventy yards should have a deflection at the centre of about eighteen inches, to allow for contraction in cold weather. If the line passes

over very rocky country it may be necessary to screw the insulators upon iron rods, which are inserted in holes drilled in the rock, and soldered. Ordinary line wire will make a span of five hundred yards, if necessary to cross rivers, etc., provided it is not smaller than No. 9. Wire for spans should be free from joints and the supports should be made as strong as possible—a large tree, trimmed free of all branches, being good.

SEMI-PERMANENT LINES.

91. A route or semi-permanent telegraph line is one put up, usually along the line of communications, to connect an army with the commercial system of the country. It is built hastily, a light wire being used, with trees, etc., as supports. The instructions given above are deemed sufficiently full to enable one to put up such a line. If the army continues to advance the semi-permanent line is replaced by a permanent one.

FLYING TELEGRAPH.

92. In the field it is necessary that the different headquarters of an army be in close communication with each other, and as these headquarters may be moved daily, a telegraph line to fulfill the required conditions must be capable of being quickly put up, and as quickly taken down. Such a line is called a field or flying telegraph.

93. A flying telegraph train consists of a battery wagon (which is also used as an office), wire wagons, and lance trucks. The ground connection is usually made by a bar of iron provided with binding screws. This is driven three or four feet in the ground and the earth moistened around it. A piece of water pipe or gas pipe, or even a bayonet, are good substitutes.

94. The wire may be plain galvanized iron, No. 14 gauge. This gives a resistance of fifty-five ohms, and weighs ninety-six pounds to the mile. Insulated cable is more suitable, especially for crossing wide streams, or where the use of an aërial line would be impracticable. Such a cable consists of a core of copper or steel wires, or both, and this core is covered with an insulating material, around which steel or iron wires are spirally wound, and the entire cable covered with a woven envelope. The outside wires may be used for the return circuit.

95. The supports for the wire are lances of cypress or pine wood, seventeen feet long and two inches in diameter, pointed at the butt and iron shod at the top to receive the shank of the insulator. The insulator used by the United States Signal Corps is made of hard

rubber, bell shaped, and is three inches long by one and one-half inches in diameter at the base. It is provided with an iron shank which screws into the head of the lance. Every fourth insulator has an iron clamp screwed into the top, to keep the wire from running through it; the others have a notch instead of a clamp, through which the wire runs freely.

96. To connect up the line, drive the bar about two-thirds its length into moist earth. Connect the bar with the zinc pole of the battery, and the copper pole with the instruments, in the manner to be hereafter explained.

97. A convenient strength for a flying telegraph party would be: One officer in charge of party, one director, the necessary number of markers, one surveyor, one chainman, two pinmen, seven barmen, two wiremen, seven lancemen, and the necessary number of operators and drivers; making in all a total of one commissioned officer, six non-commissioned officers, and about twenty-five privates. The director moves ahead of the party with the necessary number of men, and establishes them on the desired line in sight of each other. A surveyor and chainman follow, the latter carrying a chain one hundred and thirty-two feet long. At each chain's length a marking pin with a piece of white cotton tied to it is stuck in the ground. Successive barmen, each having a crowbar with the lower two feet of its length squared, dig holes at the pins for the lances, the pins being left standing. A lance truck distributes the lances, the above mentioned proportion of insulators with notches and with clamps being observed. At about three hundred yards behind the lance truck comes the wire wagon, closely following the line of poles, so as to avoid delivering slack wire. The wire wagon is followed at a distance of two hundred and fifty yards by the lancemen, who erect the lances, tighten the wire, and complete the line. The general rules laid down for permanent lines should be followed in erecting a flying line.

98. To make a splice in an insulated cable, cut the exterior covering lengthwise, untwist the outer wires, cut the insulating coating lengthwise, but on the opposite side of the cut in the exterior covering; splice the interior wires, wrap both ends of the insulator over the splice, one above the other, the cut edges on opposite sides; treat the outer wires and covering in a similar manner, and finally wrap a piece of insulated tape, four inches long, lengthwise around the break, and wind the whole tightly with tape, drawing the ends snug and tucking them in.

99. The reel may be fastened in the wagon or on the back of a horse or mule, or it may be carried by two men. In case of emergency the cable may be laid along the ground, or even under water. Wherever there is danger of injury, however, as in cross-

ing roads, it should be elevated on poles. The line should be constantly patroled by mounted men, if possible.

100. In recovering the line, the lances should not be taken down more than ten in advance of the wire wagon. The wire should be carefully wound in compact coils of about one-half mile each, cutting it, if possible, at the original splices. Each coil should be wrapped with four double tie wires, and the latter connected with each other by a long wire encircling the outer circumference of the coil, so as to keep them equidistant from each other.

SUBMARINE CABLES.

101. In the construction of a telegraph line it is sometimes necessary to use submarine cables for crossing wide rivers, bays, inlets, etc. These cables are usually insulated with india rubber or gutta percha, the insulation being covered with metallic armor for protection. They are wound upon reels before shipping, and should be laid directly from the reel, which can be carried in a row boat or larger craft. The best bottom for a cable is one having an even surface, free from sand or rocks. The shore ends should be buried in trenches, running from low water mark. The junction of the line wire with each shore end should be made in a waterproof box; each end should also have a lightning arrester. The splicing of a submarine cable is similar to that of any other cable.

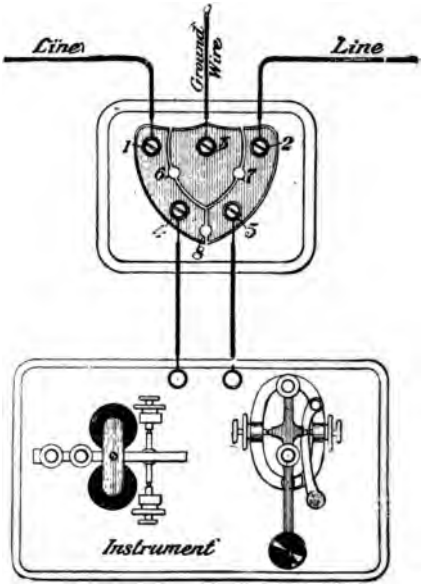
OFFICE CONNECTIONS.

102. At the window nearest the instruments the wire of a telegraph line should be attached to two brackets, a few feet apart. It is then cut midway between the brackets, and each end continued into the room by insulated copper wire. The connection is made as described for the copper pole of a battery. If a connector is used, it is well to bend the copper wire double for an inch or so from the end. A small hole bored in the window casing will effect an entrance. The copper wire should be of such size that its resistance will, as nearly as possible, be equal to that of the line wire. The following table gives the size of copper wire that should be used with each size of iron wire heretofore mentioned:

IRON WIRE.	COPPER WIRE.
No. 4	No. 11.
No. 6	No. 13.
No. 8	No. 14.
No. 9	No. 15.
No. 12	No. 18.
No. 14	No. 20.

If there is much danger from chafing, a rubber tube may be inserted in the hole made in the window casing for the entrance of the wire.

OFFICE INSTRUMENTS.



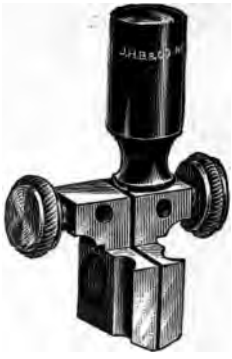
UNION LIGHTNING ARRESTER CONNECTED WITH INSTRUMENT.

103. The first connection is made with the lightning arrester, which should be secured to the wall above all other instruments. Lightning arresters are of many kinds, but all are constructed on the same principle. The "Union Lightning Arrester and Ground Switch" is excellent for a line not over fifteen miles long. It is set up as shown in the illustration. To cut out the instruments, insert the peg in No. 8. To use as a ground switch, it must be remembered that the electric current flows from the positive pole of the battery to the negative, thence through the line, instruments and ground, back to the starting point. If the current comes in *over the right* hand wire, the peg should be inserted in the right

hand hole, No. 7, to ground it; if over the left hand wire, it should be inserted in the left hand hole, No. 6, for the same purpose. The instruments should be cut out when there is danger from lightning.

PLUG CUT-OUT.

The plug switch, cut-out, lightning arrester, and ground combined is a useful instrument on a main line. The wires leading to the instruments are connected with the plug; the other connections are made as above described. To cut out the instruments pull out the plug.

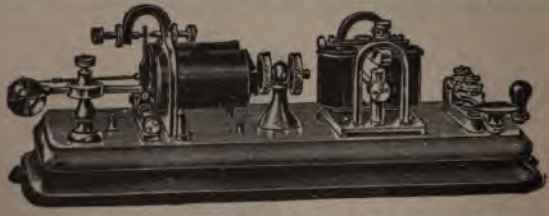


PLUG FOR CUT-OUT.

104. Next comes the switch. This is often combined with the lightning arrester, although it may be separate. It is used for changing wires to and from different lines and instruments, and as it is unnecessary at offices having but one wire entering them, it will not be further considered.

WESTERN UNION RELAY.

105. From one binding post of the lightning arrester the wire passes to the relay, thence through the relay coils to the key, and



COMBINATION SET; RELAY, SOUNDER, AND KEY.

BOX RELAY, WITH KEY.

thence through the key to the other post of the arrester. If the station is a terminal one the ground wire from the lightning arrester may be connected to the line wire between the battery and the ground plate, or in case there is no battery, just above the ground plate. The remaining two binding posts of the relay are connected with a sounder, with two cells of local battery between. Relays should all be of the same resistance on any one circuit. The sounder is employed to give a louder and more distinct sound than is given by the relay. For a line of less than fifteen miles in length the relay and local battery may be dispensed with.

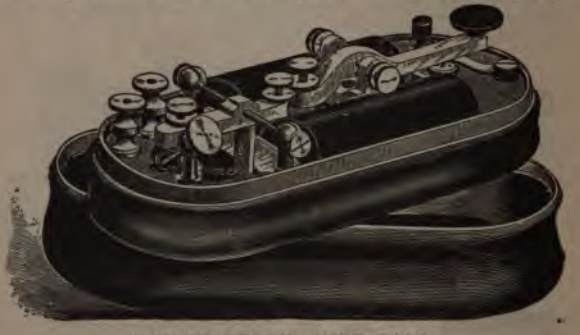
STANDARD LEGLESS KEY.

KEY WITH LEGS.

106. A pocket relay is used for tapping lines and a box sounding relay for the flying telegraph. Both of these instruments make it possible to dispense with the local battery, and they combine the sounder and relay in one. The pocket relay is contained in a case whose outside dimensions are about as follows: length, 5¾ inches; width, 2¾ inches; and depth, 2½ inches.

107. The instruments should be firmly fastened to the desk or table. Connections should be made with the same size copper

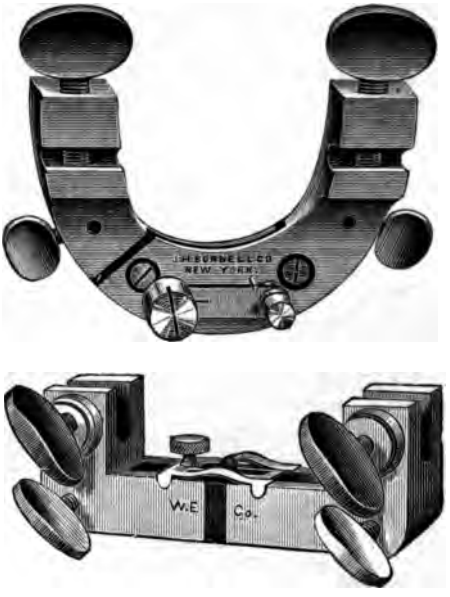
wire previously described, the insulation being scraped off for about an inch and the wire made bright. Slack may be taken up by winding the wire around a pencil in the former of a helix. Office wire is fastened to wood work with double pointed tacks, sometimes called office wire staples. Two wires should not be placed under one tack, as the points of the latter may pierce the insulation and short circuit the current through the tack. Instruments are adjusted by means of screws provided for the purpose.



POCKET RELAY, WITH CASE.

TAPPING A LINE.

108. The line should be cut near a pole, the wire being seized with the hand vise, and the latter fastened to the pole by a strap. In a friendly country the line tapping clamp may be used. With the forms illustrated the instrument wires are fastened by the lower screws, the line wire by the upper ones, and then cut between them. A circuit closer is provided, by using which the instrument wires may be removed and communication left uninterrupted. When in an enemy's country it will be necessary to conceal the cut, and this may be done by removing a section of wire and inserting a non-conductor in its place. The instrument should be connected by fine insulated wires, and, if the bark has not been removed from the pole or the line is attached to a tree, the tapping wires should be concealed under the bark. The operator should also conceal himself at some distance from the line.



LINE TAPPING CLAMPS.

DEMOLITION.

109. In the demolition of a telegraph line those parts that are most difficult to replace, such as instruments, wire, insulators, etc., should first be destroyed. It may often be advantageous to insert a piece of non-conductor, such as catgut, in the place of an equal length of wire, or to unjoint a wire, put a non-conductor between the two ends, and then make the joint again. If two or more adjacent lines be connected with a fine platinum wire their working will be seriously interfered with, and the cause will be difficult to discover.

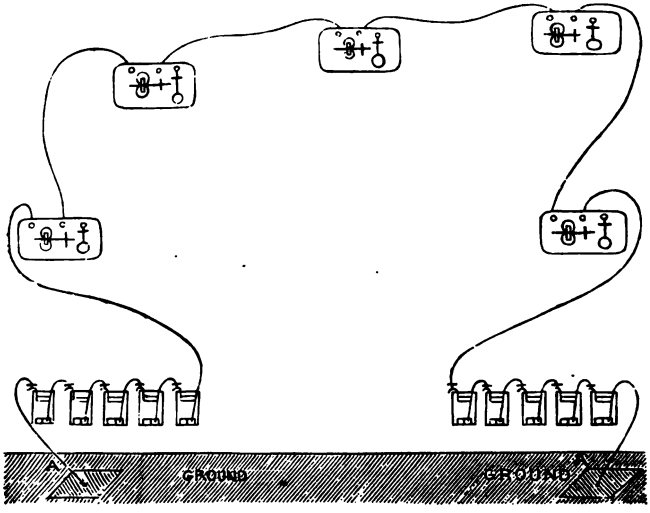


DIAGRAM SHOWING CONSTRUCTION OF TELEGRAPH LINE.

USE OF THE TELEGRAPH.

110. The American Morse code is used in telegraphy, as in other modes of signaling. A dot is made by a single instantaneous downward stroke of the key, which corresponds to a unit of time. A dash is equivalent in length to two dots, and a long dash to four dots; the space between the elements of a letter to one dot; the letter space to two dots; the word space to three dots; and the sentence space to six dots. The hand and wrist should be held as

shown in the illustration, and, as in all other modes of signaling, an even, rhythmic movement should be cultivated. The learner should not attempt to acquire rapidity at the expense of accuracy. All keys should be kept closed, except the one by which the message is being sent.

Call letters for stations and personal signals for operators are used the same as in other methods of signaling.

CONVENTIONAL SIGNALS FOR TELEGRAPH.

111. *To call a station.*—Signal the "call letter" of the station required until acknowledged, signing at intervals the "call letter" of the station calling.

To acknowledge a call.—Signal "I" three times, followed by call letter of acknowledging station.

To break the sending station.—Open the key.

To start the sending station after breaking.—Signal "G A," followed by the last word correctly received; the sender will immediately resume his message, beginning with the word indicated by the receiver. If nothing has been received, signal "RR." The sender will then repeat all.

Error in sending.—Signal seven dots (- - - - - - -) rapidly and resume the message, beginning with the last word correctly sent.

End of address.—Signal the period (- - - - - -).

Signature follows.—Signal "Sig."

To acknowledge receipt of message.—Signal "O K," followed by personal signal or initial of receiver.

MESSAGES BY FLAG, HELIOGRAPH, TELEGRAPH, ETC.

112. The following will be the order of transmitting the several parts of a message: 1st, number of message and "call letter" of sending station; 2d, operator's personal signal; 3d, the check; 4th, place from and date; 5th, address in full; 6th, period (address complete); 7th, body of message; 8th, sig. (signature follows); 9th, signature.

EXAMPLE.

The message—

"KENESAW, Ga., October 6, 1864.

General Corse, Allatoona, Ga.

Let the Rome force return at once to Rome and protect the road. I will cover Allatoona.

W. T. SHERMAN,
Major General."

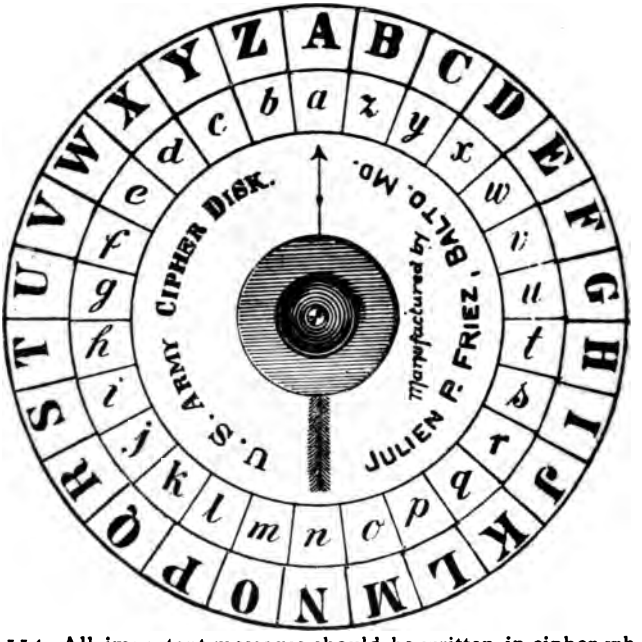
Would be sent—

No 1 K Jo 17 OB Kenesaw Ga 6 To General Corse Allatoo Ga. Let the Rome force return at once to Rome and protect t road. I will cover Allatoona Sig W T Sherman Major Gene

Abbreviations should not be used in the body of a message, a numbers occurring therein should be spelled out in full.

113. Pads prepared in accordance with the foregoing are su plied to military posts by the Chief Signal Officer of the Arm When it is desired to take duplicate copies of a message, carb paper is placed, with the prepared side downward, between t sheets, and the message written upon the upper one.

MESSAGES IN CIPHER.



114. All important messages should be written in cipher wh there is danger of their being intercepted by the enemy. A simp

method is by the use of the U. S. Army Cipher Disk. This consists of two paper or leather disks of the size shown in the illustration. The smaller is placed concentrically upon the larger, in such a way that it can be revolved, or fastened by a thumb screw. On the larger disk, and between the circumferences of the two, the alphabet is written from left to right. Around the edge of the inner disk the alphabet is written from right to left.

The letters on the small disk correspond to those of the message, and the letters opposite them on the large disk are signalled. For example: Let "a" of the small disk be clamped opposite "A" of the large, and suppose that it is desired to send the word "signal." The letters sent would be "isunap." The operator at the receiving station writes the message down as it is sent, and afterwards translates it by using his own disk, which should be adjusted the same as that of the sender. If there be no preconcerted agreement, it is customary to clamp the two "A's" together; "a" of the inner circle may, however, be clamped opposite any letter of the outer. The latter is called the key-letter.

115. To make the cipher more intricate, the key-letter should be frequently changed, which can be done by using what is called a "key-word." Each letter of this word is taken in its order as the key-letter, the changes being made at intervals of a day, or more frequently—the oftener the better. If desirable, an enciphered message may be divided into groups of four, five, or any convenient number of letters; the letters of the key-word being used in succession as the key-letters of the groups. To illustrate: Suppose it is desired to transmit the following message: "Send supply train to-day." Divided into groups of four letters each, this message will read, "Send supp lytr aint oday." If "rifle" is taken as the key-word, the first group would be sent with "r" as the key-letter, the second with "i," and so on. The message as sent in cipher would read, "Zneo qott uhmo ldys qbeg." Should there be more than five groups, "r" would be the key-letter for the sixth, and so on. The method as given in directions on back of each cipher disk is to change the key-letter after each word of the message. Example: With key-word, ACT, the signal message, "The Army will move to-night," would be sent and received: "Htw clqe xlii omfw jopuwvj."

116. The following methods will render the message still more intricate: Using a key-sentence instead of a word. Throwing in "blind words" at fixed intervals; for instance, after every fourth word—these blind words to be thrown out when the message is translated; sending the enciphered message backward, or using the key-word or message backward.

117. There is no prescribed method for indicating that "cipher follows" or "cipher ends," except with the flag, where the signa

is three circles over the head, from left to right. This can also be used with the torch. When other means of signaling are employed, "ci" might be signaled.

118. A cipher called the "Route Cipher" was used with great success during the Civil War. The message was written with the same number of words in each line, and the lines arranged in columns, with a blind word at the end of each column, and preconcerted words substituted for important nouns and verbs, such as "Grant" or "march." The message was then copied up and down the columns by a certain prescribed route, from which the method derived its name. It is said that messages sent by this cipher were never made out by the enemy.

119. As an aid in making out a cipher it may be well to remember that the order of precedence of the letters of the alphabet, according to the frequency of their occurrence, is as follows: e, a, o, i, t, d, h, n, r, s, u, y, c, f, g, l, m, w, b, k, p, j, q, x, and z. The most frequent compounds are: th, ng, ee, ll, mm, tt, dd, and nn.

THE TELEPHONE.

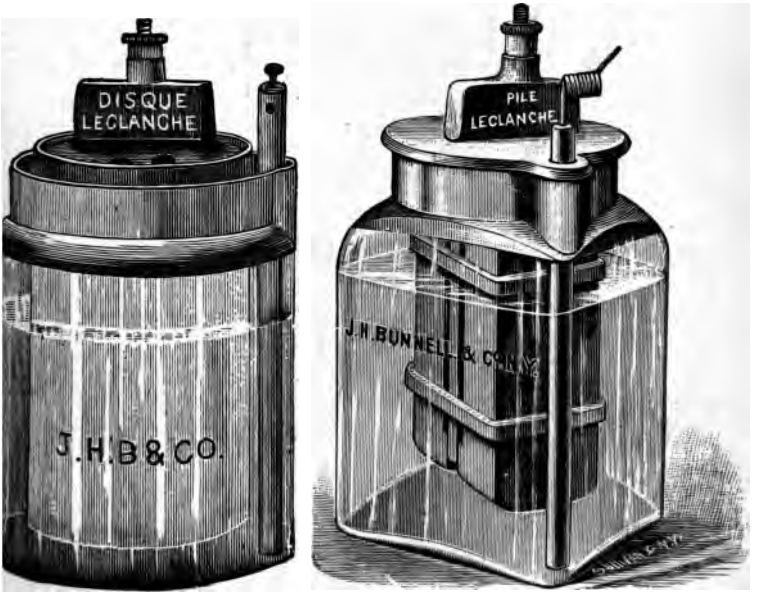
SHORT LINE ELECTRICAL TELEPHONE. NEW FORM.

120. In future wars it is likely that the telephone will be much used in the field. It is now used in the army on rifle ranges, to connect offices in the same or different buildings with each other, and also to connect military posts with the commercial telegraph systems of the country.

121. There are two kinds of telephone—the electrical and the mechanical. It is probable that in future the latter will be rarely used, and the former more extensively, on account of the recent expiration of the ground patent of the Bell telephone, and the consequent introduction of cheaper ones.

122. Where there are but two stations on the same line a single ring is all that is necessary for a call; where there are more there must be some preconcerted arrangement. The telephone should always be returned to the hook after being used, as that act puts the call bell into circuit.

123. No. 12 galvanized iron wire and the pony glass insulator are generally used in the construction of a telephone line. The line should be grounded at each terminal station after passing through the instrument, and the lightning arrester on each instrument should also be grounded. The method of setting up poles, string-



DISQUE FORM. PRISM FORM.

LECLANCHÉ BATTERY.

ing the wire, etc., does not differ from that followed in const a telegraph line.

124. In the electrical telephone the Leclanché battery i used, one cell being in the box on each instrument. This comes in two forms, the Disque and the Prism. The Disq consists of a cylindrical glass jar which contains a zinc r a porous cup, the latter containing a mixture of peroxide of n nese and carbon. A carbon plate extends into this mixture, fitted with a screw connection at the top. To set up the b put into the jar about six ounces of sal ammoniac, fill on full of water, stir well, then put in the porous cup and zi and fill with water to the neck. The wires are connected

DRY BATTERY.

usual manner. The battery should be kept in a dry place and fresh water supplied to take the place of that lost by evaporation.

125. The Prism form differs from the Disque in having the porous cup replaced by a pair of compressed prisms which are attached to the carbon by two rubber bands. These prisms are of the same composition as the contents of the cup. The same directions as to setting up should be observed.

126. When the telephone is used in the field, a dry battery may be employed. One form, the Standard, is illustrated. This battery is smaller than the other, is not subject to freezing or evaporation, and is absolutely clean.

127. Recognizing the great advantages of the telephone for military purposes, General Greely has recently adopted a form of this instrument for use in the field by the Signal Corps. A leather case, which is carried by a strap over the shoulder, contains a Bell telephone, a Morse telegraph key, a switch key, and a cell of dry battery. The receiver and transmitter of the telephone are in one piece, which can be so held by the left hand that the former is at the ear while the latter is at the mouth. A kind of knapsack, which is carried on the back, contains a reel with one-third of a mile of double conductor cable wound upon it. This cable can be used when run along the ground or under water, and is not injured by being run over by artillery wheels.

128. To open communication, call by means of the telegraph key, and when the call has been answered, place the telephone to the ear. Press down firmly with the right hand the small switch key, which is placed in the kit perpendicular to the telegraph key. This throws the transmitter into circuit. The switch key must be held down firmly as long as conversation is carried on, as the moment it is released the transmitter is thrown out of circuit and conversation is impossible.

129. The Morse key makes a very sharp click in the telephone receiver at the other end of the line, and usually takes the place of the call box in the ordinary telephone. But when heavy cannonading renders it difficult to hear spoken words in the receiver, then the operator, with his right hand, spells them out in "Morse."

130. For carrying more cable than can be placed in the knapsack, Captain Kilbourne's Outpost Cable Cart is used. It consists of a frame of bicycle tubing, mounted upon thirty-two inch bicycle wheels with heavy cushion tires. The cart carries one knapsack like that described above, and five reels of cable, one of which is in the knapsack. The reels are suspended in brackets by the axle ends. Each reel carries one-third of a mile of double conductor cable, the ends having double connectors, by means of which they can be joined together so as to extend the line. At the rear end

of the cart is a reeling apparatus having an automatic spooling attachment. Upon this apparatus, the reel to be wound or unwound is placed.

131. When a line is to be established, the free end of the cable is connected with the telephone kit at the home station, and the cable run out. If desirable, the second telephone kit may be connected with the cable while the latter is being unreeled, thus rendering it possible to send orders at any time to the men with the cart. The telephone cart when fully loaded weighs but 159 pounds, and can be easily drawn by one man. The distance between the wheels being only twenty-six inches, it can follow any ordinary path through underbrush. It is proposed to fit shafts to the cart, so that a horse may be attached to it, and greater rapidity in running out the cable thus secured. At present, however, the cable can be laid as fast as a man can walk.

132. As a means of connecting the outposts of an army with the main body, different headquarters with each other, and obtaining information from the front during an engagement, it is probable that the field telephone will be extensively used in the next war. The cable can be quickly laid, and messages can be sent with speed and without danger of being read by the enemy. Moreover, except when it is necessary to use the key, a skilled operator is not required.

133. The following is a description of the outpost cable now used by the Signal Corps: Inner conductor, one steel wire (No. 29, American gauge), surrounded by seven copper wires, No. 33. This is wound with very fine cotton and then insulated with balata compound. The balata is covered with cotton, which acts as a cushion for the tinned steel wires of the outside conductor. The latter, which consists of twenty No. 30 tinned steel wires, is formed by winding the wires around the insulated core with a long lay. The outside conductor is covered first with cotton braid, and then with strong linen thread braid. The resistance of the inside conductor is twenty-five ohms per 1,000 feet, and that of the outside conductor forty-nine ohms for the same distance.

ELECTRIC BELLS.

134. These may be properly considered a means of signaling, but although used at most military posts, and properly under the charge of the Acting Signal Officer, they would, of course, not be used in the field.

135. The principal parts are wire, push buttons, battery, and bells. Insulated copper wires, arranged in a complete circuit, are used, unless different buildings are connected, in which case the return circuit may be made through the ground. If a wire is run

ELECTRIC BELL OUTFIT.

under ground, it should be encased in a lead pipe. The button may be placed on the desk or wall and pressed with the finger, or on the floor and pressed with the foot. The two wires are connected to the base of the button as shown in the cut. When the button is

INTERIOR OF PUSH BUTTON.

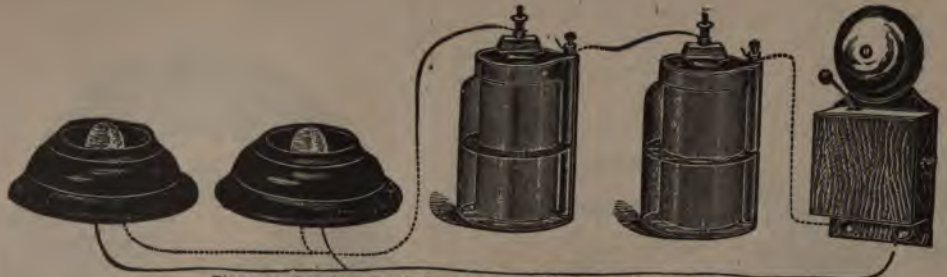
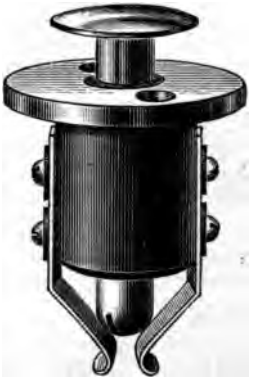


Diagram showing circuit for two Push Buttons for a single Bell.

Diagram showing circuit for ringing two Bells from one Push Button.

pressed the spiral spring is forced downward until contact is made, by which the circuit is completed and the bell rung. The Leclanché battery is usually employed. The bell as furnished by the dealer is all ready to be set up, it being only necessary to attach the wire to the binding posts. When a quiet call is desired, the bell is replaced by a buzzer. In this the hammer strikes a sounding piece instead of a gong. The cuts show how the connections are made when two or more buttons are used to ring one bell, and when one button is used to ring two or more bells.



FLOOR KEY.

136. If so many buttons connect with one bell as to cause confusion, an annunciator may be used. In this there is an electro-magnet corresponding to each button. In setting up an annunciator, first run a wire from the carbon pole of the battery to the button farthest off. This is called the carbon wire, and should be of a different color from the others, for identification. Next run wires from each button to the carbon wire, and from each button to the binding post of the corresponding electro-magnet in the annunciator. Lastly, run a wire of different color from any of the others from the zinc pole of the battery to the bell.

OTHER METHODS OF SIGNALING.

137. Other methods of signaling that may prove very useful at times are rockets, semaphores, puffs of smoke, fires by night, and balls hoisted up and down upon the roof of a building. With some of these methods it is possible to use the regular code, but with the others it is not, and their use is therefore very limited.

BALLOONS.

138. In future warfare balloons will prove a very important factor in signaling and reconnoissance. From them the position and movements of the enemy can be observed and immediately reported to the commander. The dirigible balloon is still in an experimental stage, but it is believed that the captive balloon and its equipment have been sufficiently perfected for successful use. The inflating substance is usually hydrogen gas, compressed in steel tubes, and transported in wagons wherever necessary. The balloon is controlled by a rope, which contains several strands of insulated copper wire, for use as a telephone cable. It has been proved by experiment that a position two miles in rear of the firing line during a battle renders the balloon perfectly safe from bullets or artillery projectiles.

APPENDIX I.

INSPECTION OF SIGNAL DETACHMENT.

A signal detachment when on foot is formed and manœuvered as infantry. The positions of the kit hereafter mentioned correspond as nearly as possible to those of the rifle.

The following form of inspection for a dismounted detachment with kits is taken from Myer's Manual of Signals, modified to conform to the Infantry Drill Regulations:

The detachment being formed, kits at an order, haversack on the right side and canteen on the left side, the first command will be: 1. *To the right (or left) take intervals.* 2. **March.** At the first command the rear rank steps back four paces; at the command march, the man on the left of each rank stands fast; the other men face to the right and step off, each man halting faced to the front, when he has the interval of four paces. Each rank will align itself to the left (right) without command, the alignment being verified, and corrected if necessary, by the officer in charge.

The inspector will then pass down both ranks, and closely observe the general appearance of the men, their kits, clothing, and bearing. As soon as the inspection is finished, the officer in charge will command: 1. *Unpack.* 2. **Kits.** At this command the kits will be placed on the ground in a line parallel to the rank, and twelve inches from the feet of the bearers. Each man then stooping over, will unstrap and open his kit, take out the torches, putting a flame shade and extinguisher on each, and place them in front of their respective pouches and perpendicular to the line of kits, and then resume the attention. The kits should be opened with the butts of staffs to the left.

At the command: 1. **Flags and torches,** the flags will be neatly folded in two folds, and laid upon the kit with the ties to the front. The white flag will be laid upon the torch case with its red center uppermost, and the red flag folded in the same manner and laid immediately in rear of the white flag. This completed, each man will resume the attention, with a torch in each hand, and will present them in turn to the inspector as he approaches. The latter will closely examine each as to the fit of the flame shade, and will particularly notice the condition of the thimbles and screws, and the wedge strips. The shades may be tightened by bending the cylindrical part before putting them on the torches, or by pressing the shades firmly on the wedge strips. When screw caps leak they should be fitted with packing made of a circular piece of cork, leather, or india rubber, cut to fit the interior of the caps. Each man, as the inspector passes, will place the flying torch on the ground in front of its pouch, return the flame shade of the foot torch to the haversack, replace the torch in its pouch, fold up the flags and put them in their proper places, and then resume the position of attention.

This inspection over, the command will be, 1. *Join* 2. **Staffs.** At this command each man will join his staff together and stand at ease. When the inspector reaches him the man will present his staff with the right hand. The inspector will see if the joints fit perfectly, and if the staff be clean and in good order. The next command will be, 1. *Attach* 2. **Torches.** The third joint of staff will be removed, and the flying torch attached. The inspector will then examine each man's torch in detail, receiving it from the right hand of the flagman. Each man as soon as the man on his left (or right) is inspected will detach his torch, remove the flame shade and put it in the haversack, return the torch to its pouch, unjoint his staff, and put the joints in their beckets.

This inspection finished, the next command will be, 1. *Open* 2. **Haversacks.** The haversacks will be held open by each man with his right hand. The inspector, passing in rear of each rank, will look for the proper number and condition of articles in haversacks, and at the same time examine the canteens, noticing particularly the condition of the screw caps. Each haversack will be closed as soon as the inspector passes.

The inspection finished, the command will be, 1. *Repack* 2. **Kits.** Each man will close his kit and resume the attention. The command will then be given, 1. *To the right (or left) assemble;* 2. **March.** The front rank man on the right stands fast; the other men close in to their proper places. The detachment will then be dismissed, or exercised with the apparatus in the kit.

Inspection of arms is executed as prescribed in the Drill Regulations.

APPENDIX II.

ABBREVIATIONS USED ON COMMERCIAL TELEGRAPH LINES.

Abt.....About.
Altho.....Although.
Art.....All right.
B.....Be.
Bkfst.....Breakfast.
Bk.....Back.
Bn.....Been.
Brk.....Break.
Brot.....Brought.
Bt.....But.
Btwn.....Between.
B4.....Before.
C.....See.
Cn.....Can.
Cum.....Come.
Dnr.....Dinner.
Dwn.....Down.
Fm.....From.
GB.....Good-bye.
Gess.....Guess.
Gg.....Going.
Gi.....Give.
Hr.....Here.
Hv.....Have.
Hw.....How.
K.....O'clock.
Lv.....Leave.
Mite.....Might.
Nite.....Night.
No.....Know.
Wy (Y).....Why.
Ntg.....Nothing.
Nw.....Now.
R.....Are.
Rite.....Write, or Right.
Sa.....Say.
Sed.....Said.
Shld.....Should.
Sine.....Who is at the key?
Supr.....Supper.
T.....The.
Tho'.....Though.
Thot.....Thought.
Thru.....Through.
Ti.....Time.
Tk.....Take.
Tn.....Then, or Than.
Tng.....Thing.
Tnk.....Thank, or Think.
Tr.....There.
Ts.....This.
Tt.....That.
U.....You.
Vy.....Very.
Wi.....With.
Wk.....Work.
Wld.....Would.
Wn.....When.
Wo.....Who.
Wr.....Where.
Wt.....What.

APPENDIX III.

U. S. NAVAL CODE FOR VISUAL AND TELEGRAPHIC SIGNALING.

(Authorized by G. O. No. 34, Headquarters of the Army, A. G. O., April 26, 1893, for use only in communicating with the United States Navy.)

NUMERALS.

1.....1111	2.....2222	3.....1112	4.....2221
5.....1122	6.....2211	7.....1222	8.....2111
9.....1221	0.....2112		

ALPHABET.

A 22	H.....122	O.....21	U.....112
B 2112	I 1	P 1212	V ...1222
C 121	J 1122	Q 1211	W ...1121
D 222	K....2121	R 211	X ...2122
E 12	L.....221	S 212	Y 111
F 2221	M ...1221	T. 2	Z....2222
G 2211	N 11		

ABBREVIATIONS.

a ....after	h....have	t.....the	w...word
b...before	n.....not	u ....you	wi ..with
c .....can	r .....are	ur...your	y ....why

xx3, "numerals follow" or "numerals end."
sig. 3, signature.

End of a word 3
End of a sentence.....33
End of a message 333
I understand 22. 22. 3
Cease signaling.....22. 22. 22. 333
Repeat last word 121. 121. 3
Repeat last message 121. 121. 121. 3
Error..... .....12. 12. 3
Move a little to the right.....211. 211. 3
Move a little to the left 221. 221. 3

CODE CALLS.

A. S. U.....Action or Battle Signals Use.
I. C. U.....International Code Use.
T. D. U..... .....Telegraphic Dictionary Use.
G. L. U.....Geographical List Use.
G. S. U.....General Signals Use.
C. A. U.....Cipher "A" Use.
C. B. U.....Cipher "B" Use.
N. L. U..... .....Navy List Use.
V. N. U.....Vessel's Numbers Use.

INSTRUCTIONS FOR USING THE CODE.

The whole number opposite each letter or numeral stands for that letter or numeral.

TO SIGNAL WITH FLAG OR TORCH.

There are but one position and three motions.

The first position is with the flag held vertically in front of the center of the body, butt of staff at height of waist, signalman facing squarely towards the station with which it is desired to communicate.

The first motion, or "one," or "1," is a motion of the flag to the right of the sender, and will embrace an arc of 90°, starting with the vertical and returning to it, and will be made in a plane exactly at right angles to the line connecting the two signal stations.

The second motion, or "two," or "2," is a similar motion to the left of the center.

To make the third motion, "front" or "three," or "3," the flag is waved to the ground directly in front of the sender, and instantly returned to the first position.

Numbers which occur in the body of a sentence must be spelled out in full. Numerals may be used in signaling between stations having Naval Signal Books, using the Code Calls.

TO SEND A MESSAGE.

"To call" a station, signal its initial or "call letter" until "acknowledged." "To acknowledge," signal "I understand," followed by its initial or "call letter."

Make a slight pause after each "letter," also after each "front."

FOG SIGNALS.

To apply this code to the "fog-whistle" or "fog-horn:"

One (1) toot (about ½ second) will be "one" or "1."

Two (2) toots (in quick succession) will be "two" or "2."

A blast (about 2 seconds) will be "three" or "3."

The signal of execution for all tactical or drill signals will be one (1) long blast, followed by two (2) toots in quick succession.

The ear and not the watch is to be relied upon for the intervals.

TO SIGNAL WITH FLASH LANTERN.

Same as in fog-signals; substitute "short flash" for "toot," and "long steady flash," for "blast." The elements of a letter should be slightly longer.

"To call" a station—make the initial or "call letter" until "answered." Then turn on a steady flash until answered by a steady flash. The station called will "acknowledge" and cut off its flash and the calling station will proceed with the message.

No abbreviations will be used in the body of the message.

All other conventional signals are the same as for flag or torch.

A. W. GREELY,
Chief Signal Officer.

Washington, D. C., April 17, 1893.

APPENDIX IV.

No.......

Means of Communication.
Flag, Helio, Lantern, Telegraph, Telephone, Torch. (Underscore that used.)

Station...

....189......

Address:...

....

Signature:...

....

Time filed...

Sent by...

Time Sent...

Rec'd by...

Time rec'd...

Check...

U. S. ARMY FIELD SIGNAL-BLANK.

No	Sent by: Time.	Rec'd by: Time.	Check.	Means of Communication, Flag, Helio, Lantern, Telegraph, Telephone, Torch. (Underscore that used.)

From..., *189*.......

To...

....

....

....

....

....

....

....

....

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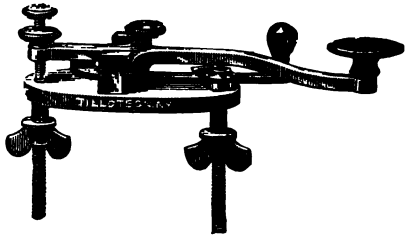

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